

WHAT IS CLAIMED IS:

1. A package substrate adapted to receive an integrated circuit, the package substrate comprising:

an upper contact layer,

a transmitter power layer,

5 a transmitter ground layer,

a transmitter routing layer disposed between the transmitter power layer and the transmitter ground layer,

a receiver power layer,

a receiver ground layer,

10 a receiver routing layer disposed between the receiver power layer and the receiver ground layer,

a lower contact layer,

electrically conductive contacts disposed in transceiver core contact patterns on the upper contact layer and adapted to make electrical connections with the integrated circuit, each of the transceiver core contact patterns including,

15 two transmitter signal contacts disposed in a transmitter signal contact differential pair and adapted to conduct transmitter signals,

two receiver signal contacts disposed in a receiver signal contact differential pair and adapted to conduct receiver signals,

20 transmitter power contacts disposed in a transmitter power contact group and adapted to provide power for only the transmitter signals conducted by the transmitter signal contact differential pair,

receiver power contacts disposed in a receiver power contact group and adapted to provide power for only the receiver signals conducted by the receiver signal contact differential pair, and

25 ground contacts adapted to provide ground for both the transmitter signals and the receiver signals,

electrically conductive transmitter signal traces disposed in transmitter signal trace differential pairs on the transmitter routing layer,

electrically conductive transmitter signal vias disposed in transmitter signal via differential pairs electrically connecting the transmitter signal trace differential pairs with the transmitter signal contact differential pairs,
35 electrically conductive transmitter power planes disposed on the transmitter power layer,
electrically conductive transmitter power vias electrically connecting the transmitter power planes with the transmitter power contact groups,
electrically conductive transmitter ground vias electrically connecting the transmitter ground layer with the ground contacts,
40 where a given one of each of the transmitter power planes is associated with and aligned with a given one of each of the transmitter signal trace differential pairs, where the association is based on the given one of the transmitter power planes and the given one of the transmitter signal trace differential pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns,
45 electrically conductive receiver signal traces disposed in receiver signal trace differential pairs on the receiver routing layer,
electrically conductive receiver signal vias disposed in receiver signal via differential pairs electrically connecting the receiver signal trace differential pairs with the receiver signal contact differential pairs,
50 electrically conductive receiver power planes disposed on the receiver power layer,
electrically conductive receiver power vias electrically connecting the receiver power planes with the receiver power contact groups,
55 electrically conductive receiver ground vias electrically connecting the receiver ground layer with the ground contacts,
where a given one of each of the receiver power planes is associated with and aligned with a given one of each of the receiver signal trace differential pairs, where the association is based on the given one of the receiver power planes and the given one of the receiver signal trace differential
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pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns, and

lower electrical contacts disposed on the lower contact layer and electrically connected to the transmitter signal traces, the transmitter power planes, the transmitter ground layer, the receiver signal traces, the receiver power planes, and the receiver ground layer,

where none of the receiver signal traces in the package substrate are disposed on the transmitter routing layer and none of the transmitter signal traces in the package substrate are disposed on the receiver routing layer.

2. The package substrate of claim 1, wherein the transmitter routing layer is disposed above the receiver routing layer.
3. The package substrate of claim 1, wherein there are no electrically conductive layers disposed between the transmitter routing layer and the transmitter ground layer.
4. The package substrate of claim 1, further comprising a second transmitter ground layer disposed below the transmitter power layer.
5. The package substrate of claim 1, wherein the transmitter power layer is disposed below the transmitter routing layer and the transmitter ground layer is disposed above the transmitter routing layer.
6. The package substrate of claim 1, wherein there are no electrically conductive layers disposed between the receiver routing layer and the receiver ground layer.
7. The package substrate of claim 1, further comprising a second receiver ground layer disposed below the receiver power layer.
8. The package substrate of claim 1, wherein the receiver power layer is disposed below the receiver routing layer and the receiver ground layer is disposed above the receiver routing layer.

9. A package substrate adapted to receive an integrated circuit, the package substrate comprising:

an upper contact layer,

a transmitter routing layer,

5 a transmitter ground layer disposed above the transmitter routing layer,

a transmitter power layer disposed beneath the transmitter routing layer,

a receiver routing layer,

a receiver ground layer disposed above the receiver routing layer,

a receiver power layer disposed beneath the receiver routing layer,

10 a lower contact layer,

electrically conductive contacts disposed in transceiver core contact patterns on the upper contact layer and adapted to make electrical connections with the integrated circuit, each of the transceiver core contact patterns including,

15 two transmitter signal contacts disposed in a transmitter signal contact differential pair and adapted to conduct transmitter signals,

two receiver signal contacts disposed in a receiver signal contact differential pair and adapted to conduct receiver signals,

transmitter power contacts disposed in a transmitter power contact group and adapted to provide power for only the transmitter signals conducted by the transmitter signal contact differential pair,

20 receiver power contacts disposed in a receiver power contact group and adapted to provide power for only the receiver signals conducted by the receiver signal contact differential pair, and

25 ground contacts adapted to provide ground for both the transmitter signals and the receiver signals,

electrically conductive transmitter signal traces disposed in transmitter signal trace differential pairs on the transmitter routing layer,

electrically conductive transmitter signal vias disposed in transmitter signal via differential pairs electrically connecting the transmitter signal trace differential pairs with the transmitter signal contact differential pairs,

electrically conductive transmitter power planes disposed on the transmitter power layer,
35 electrically conductive transmitter power vias electrically connecting the transmitter power planes with the transmitter power contact groups,
electrically conductive transmitter ground vias electrically connecting the transmitter ground layer with the ground contacts,
40 where a given one of each of the transmitter power planes is associated with and aligned with a given one of each of the transmitter signal trace differential pairs, where the association is based on the given one of the transmitter power planes and the given one of the transmitter signal trace differential pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns,
45 electrically conductive receiver signal traces disposed in receiver signal trace differential pairs on the receiver routing layer,
electrically conductive receiver signal vias disposed in receiver signal via differential pairs electrically connecting the receiver signal trace differential pairs with the receiver signal contact differential pairs,
electrically conductive receiver power planes disposed on the receiver power 50 layer,
electrically conductive receiver power vias electrically connecting the receiver power planes with the receiver power contact groups,
electrically conductive receiver ground vias electrically connecting the receiver ground layer with the ground contacts,
55 where a given one of each of the receiver power planes is associated with and aligned with a given one of each of the receiver signal trace differential pairs, where the association is based on the given one of the receiver power planes and the given one of the receiver signal trace differential pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns, and
60 lower electrical contacts disposed on the lower contact layer and electrically connected to the transmitter signal traces, the transmitter power planes, the

transmitter ground layer, the receiver signal traces, the receiver power planes, and the receiver ground layer,

65 where none of the receiver signal traces in the package substrate are disposed on the transmitter routing layer and none of the transmitter signal traces in the package substrate are disposed on the receiver routing layer.

10. The package substrate of claim 9, wherein the transmitter routing layer is disposed above the receiver routing layer.
11. The package substrate of claim 9, further comprising a second transmitter ground layer disposed below the transmitter power layer.
12. The package substrate of claim 9, further comprising a second receiver ground layer disposed below the receiver power layer.
13. A packaged integrated circuit, comprising:
 - an integrated circuit, and
 - a package substrate adapted to receive the integrated circuit, the package substrate including,

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- an upper contact layer,
- a transmitter power layer,
- a transmitter ground layer,
- a transmitter routing layer disposed between the transmitter power layer and the transmitter ground layer,

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- a receiver power layer,
- a receiver ground layer,
- a receiver routing layer disposed between the receiver power layer and the receiver ground layer,
- a lower contact layer,

15 electrically conductive contacts disposed in transceiver core contact patterns on the upper contact layer and adapted to make electrical connections with the integrated circuit, each of the transceiver core contact patterns including,

two transmitter signal contacts disposed in a transmitter signal contact differential pair and adapted to conduct transmitter signals,

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two receiver signal contacts disposed in a receiver signal contact differential pair and adapted to conduct receiver signals,

transmitter power contacts disposed in a transmitter power contact group and adapted to provide power for only the transmitter signals conducted by the transmitter signal contact differential pair,

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receiver power contacts disposed in a receiver power contact group and adapted to provide power for only the receiver signals conducted by the receiver signal contact differential pair, and

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ground contacts adapted to provide ground for both the transmitter signals and the receiver signals,

electrically conductive transmitter signal traces disposed in transmitter signal trace differential pairs on the transmitter routing layer,

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electrically conductive transmitter signal vias disposed in transmitter signal via differential pairs electrically connecting the transmitter signal trace differential pairs with the transmitter signal contact differential pairs,

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electrically conductive transmitter power planes disposed on the transmitter power layer,

electrically conductive transmitter power vias electrically connecting the transmitter power planes with the transmitter power contact groups,

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electrically conductive transmitter ground vias electrically connecting the transmitter ground layer with the ground contacts,

where a given one of each of the transmitter power planes is associated with and aligned with a given one of each of the transmitter signal trace differential pairs, where the association is based on the given

50 one of the transmitter power planes and the given one of the transmitter signal trace differential pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns,

55 electrically conductive receiver signal traces disposed in receiver signal trace differential pairs on the receiver routing layer,

electrically conductive receiver signal vias disposed in receiver signal via differential pairs electrically connecting the receiver signal trace differential pairs with the receiver signal contact differential pairs,

60 electrically conductive receiver power planes disposed on the receiver power layer,

electrically conductive receiver power vias electrically connecting the receiver power planes with the receiver power contact groups,

electrically conductive receiver ground vias electrically connecting the receiver ground layer with the ground contacts,

65 where a given one of each of the receiver power planes is associated with and aligned with a given one of each of the receiver signal trace differential pairs, where the association is based on the given one of the receiver power planes and the given one of the receiver signal trace differential pairs being electrically connected to contacts disposed within a single one of the transceiver core contact patterns, and

70 lower electrical contacts disposed on the lower contact layer and electrically connected to the transmitter signal traces, the transmitter power planes, the transmitter ground layer, the receiver signal traces, the receiver power planes, and the receiver ground layer,

75 where none of the receiver signal traces in the package substrate are disposed on the transmitter routing layer and none of the transmitter signal traces in the package substrate are disposed on the receiver routing layer.

14. The packaged integrated circuit of claim 13, wherein the transmitter routing layer is disposed above the receiver routing layer.
15. The packaged integrated circuit of claim 13, wherein there are no electrically conductive layers disposed between the transmitter routing layer and the transmitter ground layer.
16. The packaged integrated circuit of claim 13, further comprising a second transmitter ground layer disposed below the transmitter power layer.
17. The packaged integrated circuit of claim 13, wherein transmitter power layer is disposed below the transmitter routing layer and the transmitter ground layer is disposed above the transmitter routing layer.
18. The packaged integrated circuit of claim 13, wherein there are no electrically conductive layers disposed between the receiver routing layer and the receiver ground layer.
19. The packaged integrated circuit of claim 13, further comprising a second receiver ground layer disposed below the receiver power layer.
20. The packaged integrated circuit of claim 13, wherein receiver power layer is disposed below the receiver routing layer and the receiver ground layer is disposed above the receiver routing layer.